Concertainer Construction Techniques

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Developed by:

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Hesco Bastion Concertainer
Revetment Construction Techniques

Site Preparation & Foundation Construction

- The performance of Concertainer structures, as with any conventional structure, is highly dependent upon proper site selection and preparation. Concertainer structures strongly rely upon the strength of near-surface soil material for overall structural stability. The condition of these near surface materials can be deteriorated by elevated moisture levels, soil erosion, freeze/thaw cycles, decay of organic matter, compression of weak soils, etc. Therefore, the site evaluation process should include consideration of site drainage patterns and existing soil conditions for the purpose of identifying a **well drained, stable site**. Reference FM 5-34, Chapter 8 for procedures to assist in soil evaluation.
- Concertainer structures should be constructed on a relatively **flat, level foundation**. The foundation must exhibit sufficient **strength and stability** to support the structure over the intended life. If construction will not take place on an improved surface (such as concrete paving, asphalt paving, or stabilized soil), the foundation area must be prepared. At a minimum, preparation should consist of:

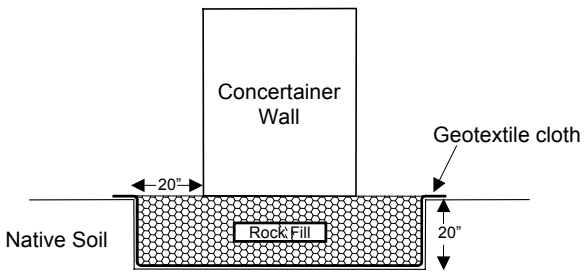
    1) Blade area to level foundation site and remove organic material and loose surface soils.
    2) Test exposed foundation material to ensure a stable foundation will be provided. FM 5-34, Figure 8-1 provides guidelines for procedures which can be utilized to test foundation soils.
    3) If exposed foundation material will not provide a stable foundation, or if the life of the structure is expected to be greater than 6 months, an **improved foundation** should be constructed to prevent future settlement and shifting.

        To construct an improved foundation, excavate a trench 20” deep beneath all structure walls. The width of the trench should extend 20” beyond each edge of the wall.

        After excavation, line the trench with a geotextile cloth (minimum weight 200 g/m^2) and backfill the trench with a **well compacted** layer of coarse graded fill material or crushed rock.

        Prior to construction of structure, test improved foundation to ensure the desired level of foundation strength and stability has been achieved.

- Reference the following detail for a depiction of an improved foundation:



End View of Improved Foundation

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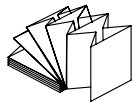


Layout and Connection

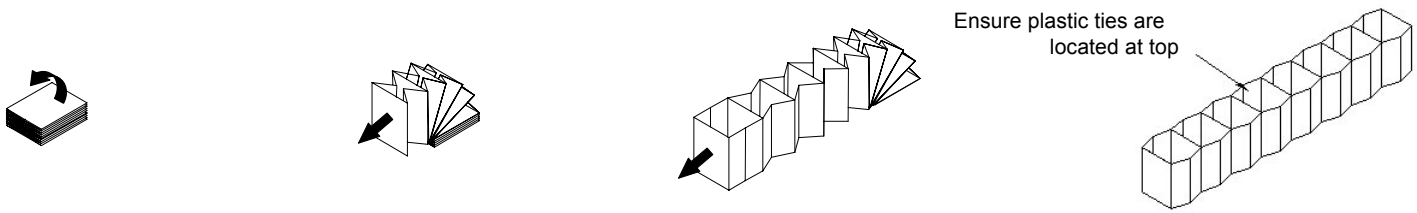
- Hesco Concertainers are manufactured in several different basic units – which are distinguished by color, the dimensions of the units (height, width, etc.) and the number of bays contained within the units. Concertainer units are presently manufactured in green, desert tan, and gray colors. The dyes used to pigment the fabrics impact resistance to UV degradation, and according to current data the gray color fabric deteriorates the fastest. **Based upon this susceptibility to UV deterioration, the gray colored fabric is not recommended for use**. Many Concertainer structure designs have been developed by the Engineer Research and Development Center (ERDC) which contain specific layout configurations and utilize multiple unit types. If it is necessary to construct a structure for which a specific design is not available, the appropriate combination of Concertainer units must be determined for the given application. However, in either situation, the basic construction guidelines contained herein should be utilized.

32’ long, 3.5’ wide, 4.5’ tall
9 bays per unit

4’ long, 2’ wide, 2’ tall
2 bays per unit

Examples of Concertainer Units

- Hesco Concertainer units are transported in a compressed, “accordion” style, and are expanded on-site to utilize for construction. **When laying out units, position the units such that the plastic wire ties attached to the units are located at the top**. This will allow for connection to additional layers of Concertainer units during the construction process.



Expansion of Concertainer Unit

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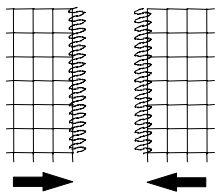
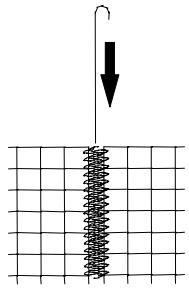
- In most applications, it will be necessary to utilize multiple Concertainer units to achieve the desired dimension and shape for the structure. When utilizing multiple units in a single layer of construction, each unit should be secured to adjacent units to provide continuity throughout the structure.

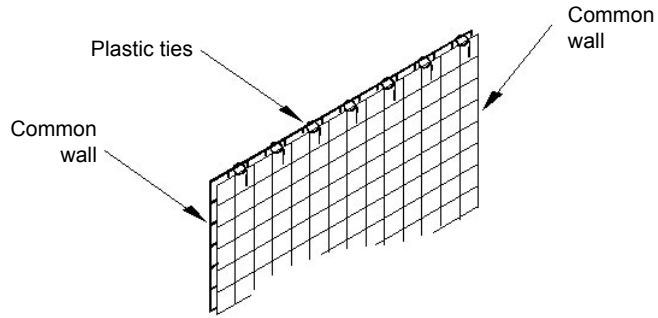
  Concertainer units are generally connected together by utilizing two mechanisms provided as a part of the Concertainer system. Concertainer units are manufactured with coil hinges located at articulation points. To connect units together, the coil hinges located at the common corners between the two units are overlapped, and a provided connecting pin is inserted into the overlapped hinges – thereby tying the corners together. Concertainer units are also manufactured with pre-positioned plastic ties located at the tops of the units. When connecting two units together, the plastic ties located along the common wall between the units should be utilized to connect the tops of the two adjacent walls.



Overlap hinges at common corners



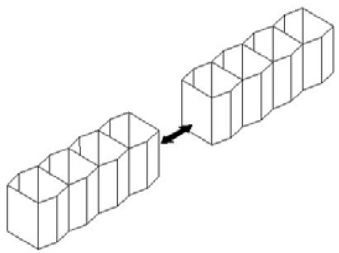
Insert connecting pin



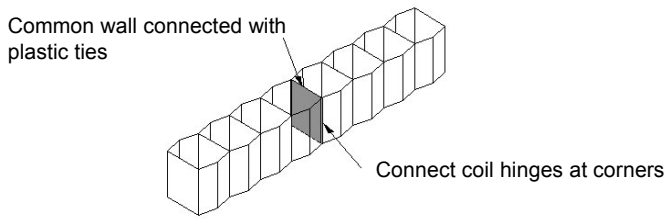
Connect common walls with plastic ties

Standard Connection Techniques

- Concertainer units can be connected end-to-end to obtain the necessary length for the structure. Units are connected end-to-end by connecting the coil hinges at the ends of the units to be joined, and connecting the common wall with the plastic ties.



Units to be attached



Units attached end-to-end

End-to-End Connection

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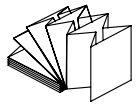
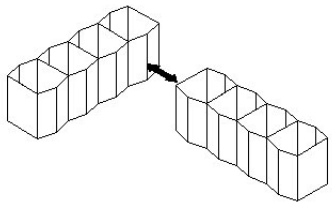
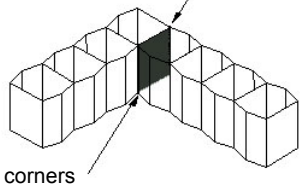


- Concertainer units can be connected end-to-side to form corners and tees as necessary. Units are connected end-to-side by connecting the coil hinges at the common corners between the units, and connecting the common wall with plastic ties.

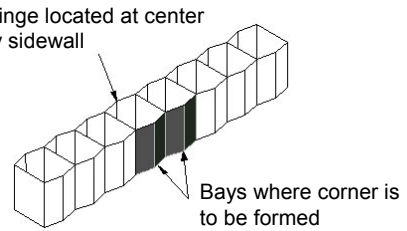


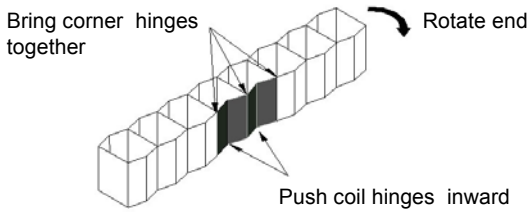
Units to be attached

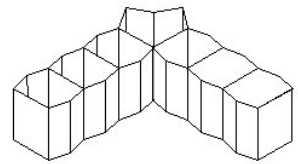


End-to-Side Connection

- In addition to forming corners in an end-to-side fashion, in certain cases corners may be formed by manipulating a single Concertainer unit. To create a corner from a single unit, the unit must contain coil hinges at the **center** of each bay sidewall. To form a corner, begin by locating two adjacent bays where the corner is to be formed. Push the coil hinges at the center of each bay's sidewall inward, and bring all three coil hinges located at the corners of the bays together. While bringing the three corner hinges together, rotate the end of the unit to form the corner. After bringing the coil hinges together, connect the coil hinges together with a standard coil hinge connection pin.







Connect hinges with pin and form corner

Single Unit Corner Formation

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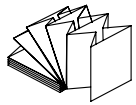
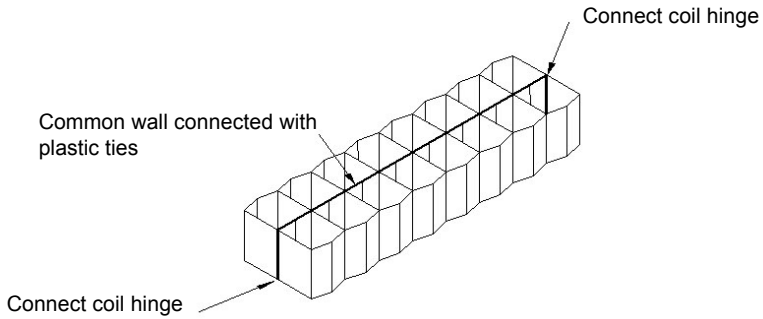


- Depending upon the height or desired wall thickness of the structure, it may be necessary to place two units together in a side-to-side fashion. When placing units side-to-side, the coil hinges at the common corners of the units should be connected with standard coil hinge connections. In addition, to prevent infill material from being deposited between the units, which may impact the overall stability of the structure, the plastic ties should be utilized to connect the common walls along the **full length of the units**.

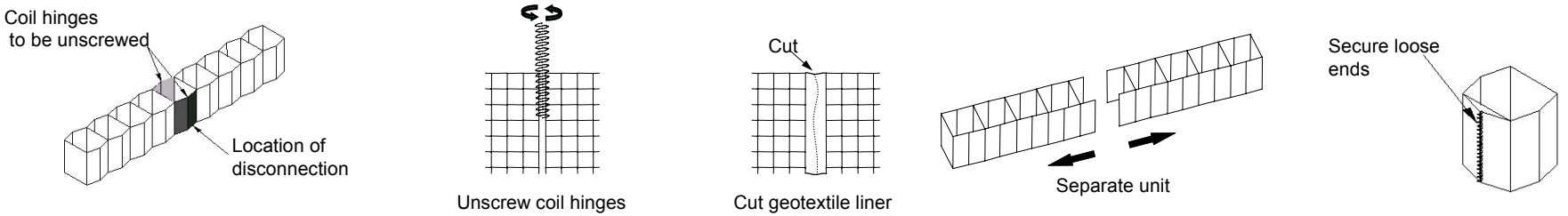


Side-to-Side Connection

Modifications

- Based upon the dimension and layout of many structures constructed with Hesco Concertainers, it is necessary to utilize non-standard unit lengths as a part of construction. In support of this necessity, Hesco units may be modified by breaking single units into smaller, multiple units.

  Units can be separated into smaller units by unscrewing the coil hinges at the center of a single bay's sidewalls. After unscrewing the coil hinges, cut the geotextile liner, fold the loose ends in, and secure with the removed coil hinges.



Unit Modification

- Note that some units are manufactured with pre-made disconnection points to ease modification. These disconnection points consist of a connection pin inserted into overlapped coil hinges. Units are modified by removing the connection pins and separating the units.

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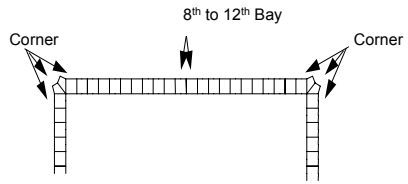
Placement of Infill

- **A basic principle behind the usage of Hesco Concertainers is the user's capability to easily create a lightweight wire/fabric "framework" for a given structure, and then fill the framework with infill material to impart structural strength and integrity. Considering that Concertainer structures therefore rely solely upon the "fill walls" for their global strength and stability, the proper placement of infill is critical to the performance of the structure. In all cases possible, the following guidelines to infill placement should be adhered to.**

- Prior to filling, connect all units in a single layer together and adjust to the desired layout. Attaching empty units to filled units is difficult.

  In general, filling of a Concertainer layer should begin by first filling corner bays, and every 8th to 12th bay thereafter, with 1' of compacted fill placed in two 6" lifts. This will allow the layer to be "anchored" during remaining filling activities.



  After anchoring the wall, filling of the remaining bays should progress such that the infill material is uniformly placed throughout the Concertainer layer (e.g. Do not completely fill one bay while the adjacent bay is completely empty).

- Concertainer walls largely obtain their load carrying capacity and stability by "bulging" along the sides during the filling process and **allowing the wire/fabric structure to deform to its "maximum state".** By allowing the bays to reach maximum deformation during filling, the infill material becomes confined within the widest, shortest volume of space available – **which significantly reduces the potential for future structure movement and failure**. "Bulging" also improves structure performance by increasing the width of the Concertainer walls, thereby creating a more stable structure.

  Restraint mechanisms – such as wires and bracing – **must not** be used to prevent "bulging" of the Concertainer. As infill is placed within the bays, the fill material exerts lateral pressures on the walls in an attempt to "push" the walls outward. This outward pressure induces stress concentrations in restrain mechanisms which can lead to failure of the restraint. Upon failure of the restraint, the Concertainer walls move outward to reach the maximum deformed state described above, and the infill material moves outward with the wall. As the infill material moves outward to occupy the void space created by the moving wall, the fill material also moves downward. This outward/downward infill movement will induce wall settlement, wall and load shifting, and potentially an overall failure of the structure.

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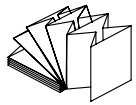
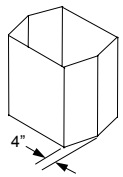


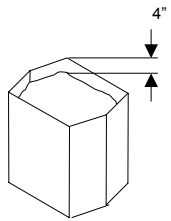
- To accommodate the deformation process previously described, the center coil hinges on each side of every bay must be pulled out approximately 4” during initial filling. If coil hinges are not present, as with Mil 2 units, simply pull the sides of each bay outward to create a slightly curved side wall for each bay. This will assist the bay in deforming as necessary during the filling process.

Pull out center of each bay approximately 4” at base during initial fill placement

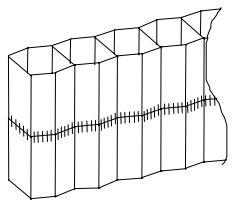


- After adjusting the base, fill the bay with infill material. **Unless otherwise specified, infill should be placed in lifts no greater than 9” in thickness and must be adequately compacted**. Adequate compactive effort can be obtained through foot compaction. During compaction, care must be taken to ensure that all infill material is compacted along the walls and in the corners. **Proper compaction of infill material is critical to prevent future settlement of Concertainer walls.**

- If a 2nd level of units is to be placed on top of the first**,** halt filling of the first layer approximately 4” from the top of the unit.



Place the 2nd layer on top of the 1st. **The 2nd layer must be positioned to ensure that it is correctly aligned with the 1st layer**. To achieve this alignment, place the second layer such that the bay corners of the 2nd layer are located directly above the corners of the 1st. This will allow the walls of the 2nd layer to lay directly on top of the walls of the first, and thereby help prevent infill leakage and enhance structural stability.



Ensure corners are properly aligned.

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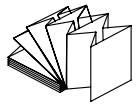
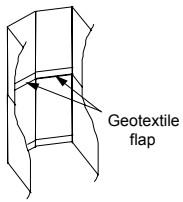
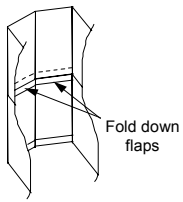
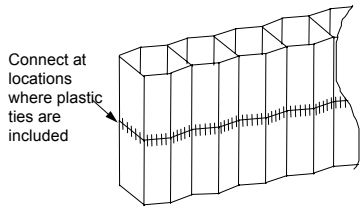


- After correctly positioning the second layer, seal the wall junctions with the geotextile flaps located at the bottom of the second layer, and connect the layers together with the pre-positioned plastic ties.







- Continue to fill the second layer in the same manner as the first layer.

Durability

- Considering that Concertainer structures will typically be placed in an exterior environment, consideration must be given to addressing environmental impacts on the intended life of the structure.

  A primary environmental factor affecting the long term performance of the Concertainers is UV degradation. As the result of exposure to sunlight, the fabric liner on the Concertainers may deteriorate over a period of time – thereby releasing the infill contained within the Concertainer units. As a part of the manufacturing process, Concertainer fabrics are colored with dyes which can impact UV resistance. Based upon current information, the expected life of the available fabric colors are:

  i. Gray – 1 to 2 years

  ii. Green – greater than 6 years

  iii. Tan – no data available

- Dependent upon the climatic environment, surfaces where infill material is exposed to wind can be affected by wind scour. In highly windy environments, it is possible that some fill materials may be scoured away by wind action. This type of scour activity can negatively impact the structure if it is allowed to undermine soil surfaces which support roof structures, or scour the roof cover to such an extent that adequate cover is no longer provided. In these conditions, measures such as capping the exposed fill material with sand bags can be utilized to mitigate the wind action. However, care should be taken to ensure that the use of capping materials does not create an inadequate bearing surface for roofs or other structures which may bear upon Concertainer walls.

- In regions which receive high levels of rainfall, moisture infiltration may impact the durability of Concertainer structures. Dependent upon the degree of compaction utilized during infill placement, as well as the type of infill material used, excessive moisture infiltration into the “soil walls” of the structure may induce infill settlement and /or weaken the load carrying capacity of the wall. In addition, excessive exposure to moist conditions may promote the degradation of the fabric liners. Therefore, in environments in which high levels of moisture are expected, the user may elect to place a waterproofing mechanism (such as a paint or membrane) over exposed surfaces to mitigate water infiltration. If a waterproof mechanism is implemented, some form of drainage must be provided to supply a drainage path for any water that may still infiltrate the walls. In addition, care should be taken not to impact the load carrying functions of the structure, or to negatively impact any concealment objectives.